

for Lakes Michigan and Superior, but while the center of the disturbance passed directly over the Great Lakes, its energy was rapidly lost and no strong winds followed. The severe disturbance which covered the Rocky Mountain Region and the Great Plains on the 3d, 4th, and 5th acted in much the same manner as it approached the Lake Region, except that it took a more northerly course, and the storm warnings that were ordered were not justified.

Another storm which had been causing severe conditions throughout the West on the 11th and 12th, including heavy snow, gradually lost its energy in approaching the Great Lakes Region. Northeast storm warnings, however, that were ordered on the morning of the 12th for the southern half of Lake Michigan were justified at Chicago with an onshore wind of 37 miles.

Small-craft warnings were ordered on the morning of the 17th for eastern Lake Michigan and Lakes Huron, Erie, and Ontario, as a disturbance crossed the Great Lakes with its center far to the north, and verifying velocities were registered at a few stations. The strong winds, however, were accompanied by fair weather so that conditions were not in the least critical.

A storm which appeared in the northern Rocky Mountain region on the night of the 17th lost some of its energy as it approached the western Lake Region, but, nevertheless, warnings ordered for Lakes Superior, Michigan, and Huron were verified at a few stations.

While, as I stated before, nearly all of the storms lost their intensity as they reached the Great Lakes, there were two exceptions in the last decade of the month, one on the 23d and one on the 30th. The first of these two storms had no indication of increasing severity. Small-craft warnings were ordered on the morning of the 23d for all lakes except extreme western Superior, and these were changed to storm warnings at 1 p. m., verifying velocities being registered at a large majority of stations.

On the morning of the 28th an extensive barometric depression covered the Canadian Northwest, and on the 29th the head of this storm had reached the Lake Superior region, but a secondary disturbance was then developing over the Great Basin. The latter rapidly became the main disturbance and moved in a northeasterly direction its center passing over Lake Superior on the night of the 30th. Warnings were ordered on the 30th for all lakes except eastern Lake Superior, and at night they were lowered on the western portion of that lake because of the omission of an important word from the Duluth signals which indicated that the storm was rapidly losing force. As an unavoidable consequence of this and the fact that night reports are not received at Chicago from either Houghton, Mich., or Wausau, Wis., the two stations nearest to Duluth and in close proximity to the storm center, the warnings on Superior were not handled in the manner the situation demanded. This is a marked example of the necessity of accurate reports for use in forecasting. Moreover, generally speaking, from the standpoint of the forecaster, the work of handling the storm warnings on the Great Lakes during the whole month was most difficult because of the erratic action and movement of the various disturbances.

No general cold-wave warnings were issued during the month, and frost warnings for only a limited area in the extreme southeastern portion of the region, the latter terminating about the 15th, as there were no crops there after that date susceptible to injury.

Stock warnings were issued for the Dakotas on the 18th and on the morning of the 30th because of the threatening and severe conditions anticipated in con-

nection with the movement of the storms which passed northeastward toward Lake Superior.

Special advices for a week in advance have been sent from the beginning of the month to the Wenatchee Valley Traffic Association, Wenatchee, Wash., in connection with the shipment of fruit across the frontier States of the Northwest, and it has shown in various communications high appreciation of the service rendered.

The Chicago Weather Bureau office is making a special effort to get in even closer touch with the advertising interests in order to better guide these as to the time of publishing and the character of the ads. Many of the advertising managers of large establishments are in daily touch by telephone with the forecaster, and much appreciation has been shown of the service. The following letter received from the H. Paulman & Co. under date of November 23, which handles Pierce-Arrow motor cars and trucks, refers to an instance of such special service:

"We wish to thank you very much for the kind cooperation your department showed us last Saturday in advising us when you expected the first freeze.

"I do not know that we ever got so much consideration from a public department as we did from you, and, while I hope it will not be necessary to bother you again in the future, it would at least be a pleasure to do so."

—H. J. Cox.

NEW ORLEANS FORECAST DISTRICT.

The weather was exceptionally mild for the season, and frost warnings were continued longer than usual for the northern portion of the district. Colder weather during the last decade made frost warnings necessary in the interior of the southern portion, and warnings were issued accordingly. The frost warnings were verified except in a few instances characterized by persistent cloudiness.

On the 11th, with moderately low pressure over western Texas and high pressure over the northern and middle Rocky Mountain States, cold-wave warnings were issued at night for the Texas Panhandle and western Oklahoma. The warnings were extended the next morning over Oklahoma, northwestern Arkansas, and the northwestern and north-central portions of east Texas, a hard freeze being predicted for the northern portion of west Texas; and the warnings were given to stockmen. The cold wave occurred over part of the northwestern portion of the district, but was prevented from extending farther by the northward movement of the low, a trough of low pressure being maintained over the central portion of the country for two days, while the western high became less intense and pressure increased over the Great Lakes. No other cold-wave warnings were issued or required.

Northwest storm warnings were displayed on the Texas coast because of conditions shown on the 8 p. m. map of the 12th, but were only partially verified, as the area of high pressure diminished greatly in intensity as it moved southward.

Small-craft warnings were displayed on the middle coast of Texas on the 22d and locally by the official in charge at Corpus Christi, Tex., on the 4th, 21st, and 30th. These warnings were justified.

Fire-weather warnings for forested areas in Arkansas and Oklahoma were issued on the 4th and 30th.—*R. A. Dyke.*

DENVER FORECAST DISTRICT.

A low which began to develop on the southern Rocky Mountain Plateau on the 1st had moved by the evening of the 3d to northern New Mexico, whence it advanced

northeastward with increasing intensity to Minnesota. This disturbance was attended by snow or rain in all portions of the district, although the precipitation was light in southern New Mexico and southern Arizona and was followed by a cold wave in central Arizona, northeastern New Mexico, and southeastern Colorado.

On the morning of the 4th, when the storm was central over southeastern Colorado, violent local storms occurred in the eastern portion of the State. A tornado that appears to have originated 5 or 6 miles south of Sugar City, in Otero County, moved northward and northeastward through Lincoln, Washington, Yuma, and Phillips Counties, disappearing about 5 miles northeast of Amherst. Three persons were reported to have been killed outright and 10 injured, 2 so seriously that they died the following day. The total property loss was in excess of \$130,000.

Warning of a moderate cold wave was issued on the morning of the 4th for south-central and extreme eastern Colorado and southern and extreme eastern New Mexico. On account of the slow northeastward movement of the storm, the verifying limit was not reached in the portions of Colorado mentioned until the morning of the 6th. The fall in temperature in 24 hours amounted to more than 20° in most of eastern New Mexico, but the verifying limit was not quite reached in the southeastern portion of that State.

Another storm that appeared on the north Pacific coast on the 5th moved slowly southeastward to central California and western Nevada by the morning of the 9th and had overspread the northern Rocky Mountain States and the upper Missouri Valley on the 10th. During the 10th this disturbance formed a trough of pressure that extended from the southern Rocky Mountain States to the northwestern portion of the Lake region, with separate centers over eastern New Mexico and southern Minnesota, while a high of considerable intensity developed over Montana. Snow or rain occurred in Utah, northern Arizona, and Colorado between the 9th and 12th, with heavy snow in north-central Colorado on the 11th.

On the morning of the 11th warning of a moderate cold wave was issued for southeastern and extreme eastern New Mexico, and on the evening of that date the same warning was distributed for southeastern Colorado. The warning was fully verified in northwestern New Mexico and southeastern Colorado. While a fall of 18° occurred in extreme southeastern New Mexico during the 24 hours ending at 8 p. m. of the 12th, the limit required for a complete verification was not reached until the following morning, when the coldest weather of the season occurred on the southeastern slope, the temperature falling to 2° at Denver, 6° at Pueblo, and 18° at Roswell.

Light rain in southern New Mexico on the 16th and light snow in northern New Mexico and Colorado on the 16th and 17th attended a moderate low which moved from northern Arizona to eastern Colorado on those dates.

Rain again occurred in southern New Mexico on the 21st, 22d, and 23d, and snow fell in northern New Mexico and southern and western Colorado from the 21st to the 24th, due to a most unusual storm which appeared over southwestern Arizona on the 19th and continued over that State and southern California until the 24th, without advancing eastward, a high in the meantime covering the sections to the northward and eastward.

The last storm of the month was a secondary disturbance which began to develop over Nevada on the 27th and remained nearly stationary, increasing in intensity until the 29th, after which it moved rapidly northeastward, its center having advanced to northwestern Nebraska on the

morning of the 30th. From the 28th to the 30th precipitation occurred in about all portions of the Denver district.

On the morning of the 29th live stock warnings were issued for western Colorado, extreme northwestern New Mexico, northeastern Arizona, and southeastern Utah, on account of the heavy snow and colder weather indicated for those sections. Heavy snow occurred over all of the area specified on the 29th and 30th, except in extreme northwestern Colorado, with lower though not severely cold temperatures.

Warning of a moderate cold wave was issued on the morning of the 30th for eastern Colorado and southwestern Utah. The warning was fully verified in most of eastern Colorado, but failed of verification in southwestern Utah, where a rapid increase in pressure was not attended by the usual fall in temperature.

No warning was issued in advance of the cold wave which occurred in central Arizona on the 4th. Moderate cold waves without warning also occurred in north-central Colorado on the 11th and 19th.

Freezing temperature was forecast on the morning of the 4th for south-central and southeast Arizona, with killing frost in the extreme southwest portion. On the following morning the minimum temperatures at Phoenix and Yuma were 34° and 38°, respectively, with killing frost at the former station. Frost warnings were also issued for south-central and southeast Arizona on the 6th, 10th, 12th, 18th, 19th, 24th, 25th, 26th, and 27th; for southern Arizona on the 5th, 11th, 13th, 14th, 16th, 17th, 21st, 22d, and 30th, and for south-central Arizona on the 20th and 23d. These warnings were generally verified by the occurrence of frost or frost temperatures, except those of the 27th and 30th.

Heavy to killing frost, without warning, occurred in southwestern Arizona on the 4th, and light frost in south-central Arizona on the 8th.—*J. M. Sherrier.*

SAN FRANCISCO FORECAST DISTRICT.

A large storm appeared over Alaska on the 1st and moved slowly southeastward, with its center several hundred miles at sea, and paralleling the coast until the 9th, when it curved eastward and passed inland over northern California. It gave rain or snow over the entire district from the 6th to the 10th. Another storm from the North Pacific moved inland through British Columbia and caused rain or snow over the North Pacific States on the 16th and 17th. A third storm moved inland through British Columbia giving rain or snow in the north Pacific States on the 27th and 28th. A secondary from this storm formed over the southern Plateau and gave rain in southern California and snow in Nevada on the 29th and 30th.

Storm warnings were ordered as follows: At North Pacific stations on the 3d, 5th, 6th, 15th, 17th, 18th, 21st, and 25th; on the northern California coast on the 6th, and on the southern California coast on the 9th. Advisory warnings were sent to North Pacific stations on the 20th. These warnings were generally verified and are believed to have been justified in all cases.—*G. H. Willson.*

RIVERS AND FLOODS.

By H. C. FRANKENFIELD, Meteorologist.

A further deficiency in rainfall during the month of November over the eastern portion of the country accented an already serious drought situation. Stream flow decreased materially, and in many communities